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Population synthesis of accreting white dwarfs - II. X-ray and UV emission

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Abstract

© 2015 The Authors. Published by Oxford University Press on behalf of the Royal Astronomical Society. Accreting white dwarfs (WDs) with non-degenerate companions are expected to emit in soft X-rays and the UV, if accreted H-rich material burns stably. They are an important component of the unresolved emission of elliptical galaxies, and their combined ionizing luminosity may significantly influence the optical line emission from warm interstellar medium (ISM). In an earlier paper, we modelled populations of accreting WDs, first generating WD with mainsequence, Hertzsprung gap and red giant companions with the population synthesis code BSE, and then following their evolution with a grid of evolutionary tracks computed with MESA. Now we use these results to estimate the soft X-ray (0.3-0.7 keV), H- and He II-ionizing luminosities of nuclear burning WDs and the number of supersoft X-ray sources for galaxies with different star formation histories. For the starburst case, these quantities peak at ~1 Gyr and decline by ~1-3 orders of magnitude by the age of 10 Gyr. For stellar ages of ~10 Gyr, predictions of our model are consistent with soft X-ray luminosities observed by Chandra in nearby elliptical galaxies and He II 4686 Å/H β line ratio measured in stacked Sloan Digital Sky Survey spectra of retired galaxies, the latter characterizing the strength and hardness of the UV radiation field. However, the soft X-ray luminosity and He II 4686 Å/H β ratio are significantly overpredicted for stellar ages of $\lesssim$4-8 Gyr. We discuss various possibilities to resolve this discrepancy and tentatively conclude that it may be resolved by a modification of the typically used criteria of dynamically unstable mass-loss for giant stars.

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Keywords

Binaries: close, Supernovae: general, White dwarfs, X-rays: binaries